CLAIMS

What is claimed is:

1. A method of identifying a target substance, the method comprising the steps of:

   a) illuminating the target substance with a light to produce a back-scatter;

   b) providing the back-scatter to a sample of a known substance that has been pumped with a pump light; and

   c) comparing the stimulated Raman scattering emissions from the sample to the characteristic spectrum of the target substance to thereby determine if the target substance matches the known substance.

2. The method of claim 1, wherein the target substance is a gas molecule.

3. The method of claim 1, wherein the illuminating light and the pump light have essentially identical output spectra.

4. The method of claim 1, wherein optical gain occurs at the frequencies of the stimulated Raman scattering emissions.

5. A sensing system for detecting the presence of a target substance within a target area, comprising:

   a transmitter configured to illuminate the target area to generate back-scatter light therefrom;

   a receiver containing a sample of a known substance and configured to selectively amplify the back-scatter light from the target area; and

a detector configured to process the amplified back-scatter light, wherein the detector verifies the presence of the target substance when the amplified back-scatter light matches the sample of the known substance.

6. The sensing system of claim 5, wherein the transmitter comprises an illuminating laser and optics for directing an illuminating laser beam to the target area.

7. The sensing system of claim 6, wherein the receiver comprises a hollow core fiber containing a gaseous sample of the known substance, and the receiver further comprises optics configured to direct the back-scatter light from the target area into the hollow core fiber.

8. The sensing system of claim 7, wherein the receiver further comprises a laser pump having an output spectrum essentially identical to that of the illuminating laser, wherein the laser pump energizes the gaseous sample of the known substance within the hollow core fiber.

9. The sensing system of claim 8, wherein the receiver selectively amplifies a spectrum of the back-scatter light that matches the spectrum of the energized gaseous sample of the known substance.

10. The sensing system of claim 9, wherein the receiver selectively amplifies the matching spectrum of the back-scatter light by generating stimulated Raman scattering emissions in the hollow core fiber.

11. The sensing system of claim 10, wherein the hollow core fiber is a photonic-crystal fiber configured as a holey fiber.

12. The sensing system of claim 11, wherein the detector comprises signal processing circuitry configured to identify the spectrum of the amplified back-scatter light.

13. The sensing system of claim 12, wherein the detector further comprises signal processing circuitry configured to characterize the location of the amplified back-scatter light.

14. The sensing system of claim 11, wherein the receiver further comprises a plurality of hollow core fibers with each hollow core fiber containing a sample of a different known substance, wherein the sensing system simultaneously detects a plurality of known substances in the target substance.

15. A selective amplifier for amplifying reflected Raman scattered signals of a target substance, comprising:

a hollow core fiber containing a pumped sample of a known substance having Raman scattered signals;

an optical arrangement for introducing the reflected Raman scattered signals into the hollow core fiber, wherein the reflected Raman scattered signals are selectively amplified in the hollow core fiber by stimulated Raman scattering when the spectrum of the reflected Raman scattered signals matches the spectrum of the pumped sample of the known substance.

16. The selective amplifier of claim 15, wherein the hollow core fiber is a photonic-crystal fiber configured as a holey fiber.